FLAKES UTILIZING BANANA BLOSSOM, MILLETS, AND NUTS

S. Ramalaksmi*, Gowrish T, Kavinayaa SR, Jayarajan S,

Department of Food Technology, Sri Shakthi Institute Of Engineering And Technology, Coimbatore-641062, India

Abstract

This review evaluates the nutritional, functional, and economic potential of flakes formulated from banana blossom, millets, and nuts. Such flakes address the growing demand for health-oriented, sustainable breakfast options. Banana blossom adds high fiber, antioxidants, and essential minerals like potassium and iron improving digestion and supporting cardiovascular health. Millets, rich in protein and micronutrients, offer gluten-free energy and aid glycemic regulation. Nuts contribute unsaturated fats, vitamin E, and polyphenols, providing cardioprotective and anti-inflammatory effects. Together, these ingredients promote nutrient density and sustainability, representing a next-generation functional food innovation in the cereal market.

Keywords: Banana Blossom, Millets, Nuts,Functional Foods,Breakfast Flakes, Nutritional Value, Dietary Fiber, Antioxidants, Sustainable Agriculture, Food Processing, Bioactive Compounds, Climate-Smart Crops, Plant-Based Nutrition, Value-Added Products

Introduction

The breakfast cereal sector has evolved rapidly, shifting from refined grain-based products to nutrient-rich formulations driven by rising health consciousness. Traditional cereals—often composed of corn, rice, or wheat—are criticized for high glycemic load, low fiber, and heavy sugar fortification. Consequently, food scientists have explored alternatives integrating underutilized plant-based ingredients to enhance both health value and environmental sustainability. Banana blossom, millets, and nuts provide a balanced blend of essential nutrients, sensory satisfaction, and eco-friendly sourcing (Bhattacharjee *et al*., 2019).

Banana blossom, commonly discarded in banana cultivation, is rich in dietary fiber, iron, calcium, and phytochemicals that exhibit antioxidant and antimicrobial effects (Arivalagan *et al*., 2017). Millets, as resilient grains, are high in protein, minerals, and antioxidants, suitable for gluten-free and low-glycemic diets (FAO, 2012). Nuts such as almonds and walnuts supply plant protein and healthy fats that enhance product palatability and consumer appeal. The

combination of these three ingredients aligns with current market demands for functional, sustainable, and sensory-appealing cereals.

Banana Blossom: Nutritional Value and Functional Role

Banana blossom, or banana flower, is a nutrient-dense inflorescence valued for its dietary fiber and bioactive compounds. It contains essential minerals such as iron, potassium, magnesium, and calcium, supporting blood formation and electrolyte balance (Arivalagan *et al*., 2017). The presence of polyphenols, flavonoids, and tannins contributes to its antioxidant and anti-inflammatory effects, helping reduce oxidative stress and lower risks of metabolic disorders (Senevirathna *et al*., 2024).

Banana blossom offers functional benefits beyond nutrition—it acts as a natural binder due to its fibrous structure and provides mild earthy sweetness that complements millets and nuts (Healthline, 2022). Its dietary fiber aids digestion, while magnesium supports mood regulation and muscle function. Moreover, its inclusion in flakes contributes to sustainable food systems by utilizing agricultural by-products that would otherwise be discarded, enhancing both nutritional and ecological outcomes.

Millets: Nutritional Powerhouse for Functional Foods

Millets are ancient grains known for resilience and nutritional richness. They contain complex carbohydrates with a low glycemic index, preventing rapid glucose spikes and supporting long-term satiety (FAO, 2012). Finger millet, pearl millet, and foxtail millet offer significant amounts of protein, calcium, iron, and B-vitamins that strengthen bone and cardiovascular health (B. Dayakar Rao, 2017). Their high fiber content improves gut health and aids weight management.

Millets are gluten-free, making them ideal for individuals with celiac disease or gluten sensitivity. Their antioxidant components such as phenolics and flavonoids help combat inflammation and oxidative stress (Chandrasekara & Shahidi, 2012). From a sustainability perspective, millets thrive in semi-arid conditions with minimal water requirements, making them a climate-smart crop. Integrating millets into breakfast flakes not only improves nutrition but also reduces dependency on resource-intensive staples like rice and wheat.

Nuts: Nutritional Profile and Health Benefits

Nuts, including almonds, walnuts, cashews, and pistachios, are nutrient-rich foods that provide essential fatty acids, high-quality protein, and antioxidants. Their unsaturated fats support cardiovascular health, while vitamin E and polyphenols reduce oxidative damage (Gonçalves *et al*., 2023). Consuming nuts has been associated with lower cholesterol, improved insulin sensitivity, and better weight management (Kris-Etherton *et al*., 2008).

In flakes, nuts contribute flavor complexity, crunch, and enhanced satiety, improving consumer satisfaction. Their inclusion also boosts omega-3 and omega-6 fatty acid intake, promoting neurological and heart health. Furthermore, nuts help balance macronutrient ratios in flake formulations, making them ideal for both energy and nutrient enhancement.

Processing and Formulation Strategies

The production of banana blossom–millet–nut flakes involves systematic stages: cleaning, drying, milling, flaking, and blending. Each process must preserve nutrient integrity and functional properties. Low-temperature drying and milling retain antioxidants, while steaming and flaking enhance texture and digestibility (Kanchana *et al*., 2005).

Proper blending ensures even distribution of ingredients, while natural binders like honey or malt extract improve cohesiveness and flavor. Formulation should consider ingredient particle size, moisture balance, and texture stability to maintain product quality. Advanced packaging technologies such as nitrogen flushing further prevent oxidation and extend shelf life.

Sensory Evaluation and Consumer Acceptance

Sensory studies reveal high consumer acceptance of flakes containing banana blossom, millets, and nuts. Taste panel scores generally range from 6.5 to 8.2 out of 9, with favorable responses toward texture and aroma. The earthy flavor of millets, sweetness of banana blossom, and crunch of nuts create a balanced sensory profile.

Consumer feedback highlights that natural color variations and mild nutty aroma enhance the perception of authenticity. These products appeal strongly to health-conscious and eco-friendly demographics, particularly vegetarians and fitness-oriented consumers.

Market Trends, Sustainability, and Economic Impact

The global market for banana and millet-based flakes is expanding due to increasing awareness of functional and plant-based nutrition. The banana flakes market is projected to grow from USD 569.5 million in 2025 to USD 806.7 million by 2032 (Persistence Market Research, 2025). This reflects the rising consumer shift toward clean-label and gluten-free foods.

From an environmental standpoint, millets require minimal water and fertilizers, while utilizing banana blossom reduces farm waste (Agrieconomist, 2025). Economically, value-added products from banana by-products and millets offer new income sources for rural farmers and small enterprises. Hence, these flakes represent both a sustainable and profitable food innovation.

Future Research Directions

Further studies should explore optimizing ingredient ratios for maximum bioactive retention and sensory quality. Innovations such as fermentation, sprouting, and fortification with micronutrients can enhance nutritional bioavailability. Clinical trials are needed to validate specific health benefits like glycemic control and cardiovascular improvements (Adhisakthi *et al*., 2025).

Future research may also focus on biodegradable packaging and circular economy models that minimize waste. Comprehensive life-cycle assessments can quantify the sustainability impact of large-scale production and distribution.

Conclusion

In Summary, Flakes developed using banana blossom, millets, and nuts offer a balanced, nutrient-dense, and sustainable breakfast option. They integrate fiber, proteins, minerals, and healthy fats, providing multifaceted health benefits while supporting sustainable agriculture. With continued innovation in processing, packaging, and marketing, such products hold significant promise for the future functional food market.

References

1. Adhisakthi, S., Hemavarshini, M., Kavya, T., Monika, M., & Anjali, M. (2025). *Value added breakfast cereal: A review of the formulation, processing, and nutritional benefits of banana flakes and sprouted pearl millet flour. Journal of Emerging Technologies and Innovative Research (JETIR)*, 12(5), 45–52.
2. Agrieconomist. (2025). *Sustainable management of banana waste in Sindh. Agrieconomist Journal of Agricultural Economics*, 11(3), 88–94.
3. Arivalagan, M., Kumar, R., & Subramani, R. (2017). *Nutritional and functional properties of banana blossom from different banana cultivars. Journal of Food Science and Technology*, 54(12), 4268–4276. https://doi.org/10.1007/s13197-017-2890-5
4. B. Dayakar Rao, B., & Seetharama, N. (2017). *Nutritional and health benefits of millets. ICAR-National Institute of Millets Research Bulletin*, Hyderabad, India.
5. Bhattacharjee, R., Singh, N., & Chauhan, S. (2019). *Climate-smart millets for nutritional security. Frontiers in Sustainable Food Systems*, 3, 89. https://doi.org/10.3389/fsufs.2019.00089
6. Chandrasekara, A., & Shahidi, F. (2012). *Antiproliferative potential and DNA scission inhibitory activity of phenolics from whole millet grains. Journal of Functional Foods*, 4(1), 136–145. https://doi.org/10.1016/j.jff.2011.09.002
7. FAO. (2012). *Millets: Nutritious cereals for health and food security.* Rome: Food and Agriculture Organization of the United Nations.
8. Gonçalves, B., Oliveira, C. M., & Silva, A. P. (2023). *Composition of nuts and their potential health benefits: A comprehensive review. Journal of Nutritional Biochemistry*, 113, 109237. https://doi.org/10.1016/j.jnutbio.2023.109237
9. Healthline. (2022). *Banana flower: Benefits, nutrients, and uses.* Retrieved from https://www.healthline.com/nutrition/banana-flower-benefits

10. Kanchana, S., Jayasundera, M., & Thirumaran, S. (2005). *Banana blossom as dehydrated vegetable: Slicing, citric acid treatment, and drying methods. Food Science and Technology International*, 11(6), 451–456. https://doi.org/10.1177/1082013205060589
11. Kris-Etherton, P. M., Hu, F. B., Ros, E., & Sabaté, J. (2008). *Tree nuts and peanuts as components of a healthy diet. Journal of Nutrition*, 138(9), 1736S–1740S. https://doi.org/10.1093/jn/138.9.1736S
12. Nambiar, V. S., & Dhaduk, J. J. (2013). *Nutritional and health benefits of banana flower: A review. International Journal of Food and Nutritional Sciences*, 2(3), 14–2
13. Senevirathna, C. M., Jayathilake, R. M., & Perera, L. (2024). *Banana inflorescence as a new source of bioactive and microelements. Journal of Functional Foods*, 107, 105593. https://doi.org/10.1016/j.jff.2023.105593